tients, after suprapubic prostatectomy, in whom results could be accurately determined have been entirely relieved from all symptoms or improved. After a critical review where any question existed regarding the amount of benefit the patient received, the advantage was given the patient and not to the surgeon or the operation.

PATHOLOGY OF SENSIBILITY†

By B. BROUWER *
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PATHOLOGY of sensibility is one of the chief means used in diagnosing and localizing diseases of the nervous system. Important work in this field of study has been done by Head and his co-workers in England. I take for granted that you know Head's work, hence I shall only refer to the principal points. In his conception there are three systems by which stimuli for sensibility are caught up in the periphery. The first is deep sensibility, which originates chiefly in the muscles and in the joints. By this, impulses produced by pressure and by movements are conducted to the central nervous system. The other two systems conduct stimuli caught in the skin and in the subcutaneous tissue. These systems are the protopathic and the epicritic. The former responds to painful cutaneous stimuli and to the extremes of heat and cold. The latter, the epicritic sensibility, serves for light touch, for discrimination of two points and for appreciation of the finer degrees of temperature.

In co-operation with Doctor Schoondermark I examined at Amsterdam many lesions of the peripheral nerves in man. We have seen many of the facts described by Head. Our investigations, however, did not convince us that the theory of the existence of two distinct pathways for protopathic and epicritic sensibility has yet been proved. But we felt that this work is a great advance in science, especially because phylogenetical ideas have been introduced into the doctrine of clinical sensibility and that autonomic sensibility has been brought to the foreground.

The centripetal side of the autonomic nervous system has not been so clearly analyzed as was the centrifugal by Gaskell, Langley, and others. But still we know sufficient facts to work with in physiology and in clinical examinations. In my opinion several sensory stimuli are brought from the surface of the body to the central nervous system along sympathetic fibers.

All the sensory stimuli caught in the periphery of the body are sent to the spinal cord and to the brain. For a better understanding of the matter we shall limit ourselves to the spinal cord. The same line of thought may be followed concerning sensibility of the head which is conveyed to the oblongata by the trigeminal nerve.

† Read by invitation before the 1926 annual meeting of the California Medical Association in General Session.

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The sensory impulses reach the intervertebral ganglions and then proceed through the posterior roots. Here in America Ranson found that there are many unmedullated fibers in the posterior roots. He believes that these conduct the protopathic sensibility of Head.

In the spinal cord these stimuli proceed along two separated systems. One group reaches the gray substance of the same side, and here the first sensory neuron ends. A new neuron issues in the cells of the posterior horns. It mostly crosses and proceeds upward in the anterolateral part of the spinal cord. This system comprises the stimuli for pain, heat and cold and a part of tactile sensibility. The other group avoids the gray substances and ascends in the posterior column of the same side. It ends in the nuclei of Goll and Burdach, which lie at the upper border of the spinal cord. Here it is that the second sensory neuron begins, crosses in the oblongata and ascends to the optic thalamus. These sensory pathways in the posterior columns of the spinal cord conduct stimuli of deep sensibility and a part of the tactile impulses. All these sensory stimuli are sent upward to the optic thalamus, and from there to the cortex of the brain and are there associated with many stimuli of different qualities.

Many investigators consider the sensibility of the posterior columns as a higher form. It enables us to recognize the shape and size of the objects and to distinguish two points applied simultaneously. The other form serves more for feeling and is more vital, while the former is more intellectual in character. Hence they are opposed to one another and are called the gnostic and the vital sensibility. The fact that the sensory functions of the posterior columns are regarded as a higher form of sensibility has led me to make a study of the development of these sensory systems in the scale of evolution. In the lowest classes of vertebrates, in fishes, the system of vital sensibility is present. The posterior columns, however, are very small here and contain only fibers connecting the different levels of the spinal cord. They have no nuclei of Goll and Burdach and no frontal trigeminal nucleus. These animals have only this vital sensibility, which we may call the palaeotype of sensibility. As soon, however, in the scale of evolution, as life on land has become possible, new demands are made on sensibility. Thus a new pathway is formed. This is the system which we called above gnostic sensibility. In lower animals, for example, in reptiles and in birds, this second pathway is still small, but in the ascending scale it grows and is greatest in man. We called this the younger form of sensibility, the neosensibility. Investigations, made in co-operation with Doctor Zeehandelaar, taught that in the human development the same relation is seen. So it seemed correct that this neosensibility corresponds with the above mentioned higher form of sensibility. These recent investigations, however, have shown that the palaeosensibility does not remain the same during evolution. Just as is so often seen in the central nervous system, the old parts develop further and are more finely organized in higher animals and in men. The posterior horn of the spinal cord in reptiles and in birds is

of a much simpler build than in man, and the substantia gelatinosa Rolandi, for instance, is not present there (Ariens Kappers). Hence I believe it is not correct, at the present stage of science, to speak of a higher form of sensibility which is conducted in the posterior columns and of a lower form which is conducted in the anterolateral columns. In my opinion the chief difference between these two forms of sensory pathways is the following: The so-called vital sensibility is closely connected with autonomic functions, and, as I mentioned already, much of it is brought to the central nervous system by nonmedullated fibers. At all events, it is associated in the gray substance with sympathetic centers and there causes, among other things, reflex movements in the sympathetic area. The other form of sensibility avoids the gray substance. It sends collaterals to this part of the spinal cord, but does not terminate there. These impulses sent in the direction of the cortex do not originate in the autonomic nervous system and are not associated with it. They should be called nonautonomic. The stimuli for vital sensibility cause on a high level of the brain sensory feelings. The nonautonomic system conduct impulses for gnostic sensory functions, which at a high level of the brain may cause sensory observations but no sensory feelings.

It is clear that both these forms of sensibility always work together in the cortex cerebri and that they constantly interact. It is this constant separate co-operation that enables us to form ideas of the outer world, insofar as this is possible by sensory stimuli.

It is clear that an exact knowledge of the organization of sensibility helps greatly to localize pathological processes in the brain and in the spinal cord. From all the clinical pathological syndromes, I shall take tumors of the spinal cords as an example, because these form a part of neurology, where biological research and practical application co-operate to obtain therapeutical results. These tumors of the spinal cord may cause disorders of motility, of sensibility, and of autonomic functions. The state of these disturbances depends on the level of the tumor in the spinal cord. Above all, the disturbances of sensibility enable us to localize the exact level of a tumor. The doctrine of the segmental anatomy has made it possible to do this. The part of the skin which is innervated by a segmental root is called a dermatome. There are several schemes indicating how these dermatomes are distributed. In Holland we always use Bolk's diagrams.

The principle of segmentation in the spinal cord is clearest in vital sensibility. In syringomyelia, for example, a disease in which a tumor chiefly grows in the gray substance, there are among other things analgesic areas in the skin, which may show the same form as the dermatomes.

There are also affections in which only gnostic, nonautonomic sensibility suffers. A good example of this is pernicious anemia. In the early stages of the disease we may see disturbances of deep sensibility and of finer touch in the legs, the other sensory functions being normal. In tumors which press on the outside of the spinal cord the disturbances of sensibility vary greatly. To localize the exact level of the tumors we regularly use the schemes of the diagrams. So it seems to be simple to localize tumors of the spinal cord and to send them with a correct diagnosis to the surgeon. But experience teaches that this is not so easy. Not infrequently the spine is opened and no tumor is found. One of the chief causes of this is that there is an overlap between several dermatomes.

Diagnosing the exact level of tumors in the spinal cord has lately been greatly helped by the discovery of Sicard and Forestier. After suboccipital puncture lipiodol is injected and an ex-ray examination of the spine is made. Where an extra-medullar tumor is present, the lipiodol stops, gives a shadow on this part of the spine, and thus we are able to control our clinical conclusions. We have done much lipiodol work in my clinic. In 1925 tumors were successfully removed by the surgeon (Professor Lanz) after the clinical examination had been verified by lipiodol tests. In my opinion the lipiodol test must be done when the clinical examination has led to the diagnosis of a tumor of the spinal cord.

Demonstration of diagrams and slides.

BIRTH INJURIES FROM AN OBSTETRIC STANDPOINT

By FREDERIC M. LOOMIS *

An editorial adviser in evaluating this paper for the editor states, in urging its acceptance and publication, that "it is one of the best essays on the subject that I have read. I only hope that all readers may get as much useful information from the printed copy as I received from reading the unusually clean and well-edited manuscript."

One of the discussants in a separate letter to the editor writes: "This article is interesting as well as instructive to me, and I believe that it is of the kind that helps to make CALIFORNIA AND WESTERN MEDICINE *worth while.*— EDITOR.

Intracranial hemorrhage is the most frequent birth injury, the most dangerous, and the least often diagnosed.

Premature infants, in spite of the greater ease of delivery, are much more subject to intracranial injury than those at full term.

Breech deliveries are, in proportion, much more likely to result in intracranial injury than vertex presentations.

A large proportion of intracranial injuries (up to 25 per cent) occur in normal deliveries.

Forceps deliveries are a large but uncertain factor.

The relation of mental defects in later life to injuries at birth is much argued but still unsettled.

DISCUSSION *by Alfred Baker Spalding, San Francisco; L. A. Emge, San Francisco; Edgar Brigham, Dinuba, California.*

FORTUNATELY no one of us can relate as personal experience a very large number of definite birth injuries, and a presentation of the subject must necessarily consist largely of the findings of many. However, one cannot review recent work on this subject without being convinced that we have unconsciously made "asphyxia neonatorum" on death certificates cover so many things that the term is now no more accurate than is "heart failure" as a cause of death.

In England, Germany, and this country in the

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